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NATIONAL DAM INSPECTION PROGRAM. BEAR GAP NUMBER 6 (INVENTORY N--ETC(U)
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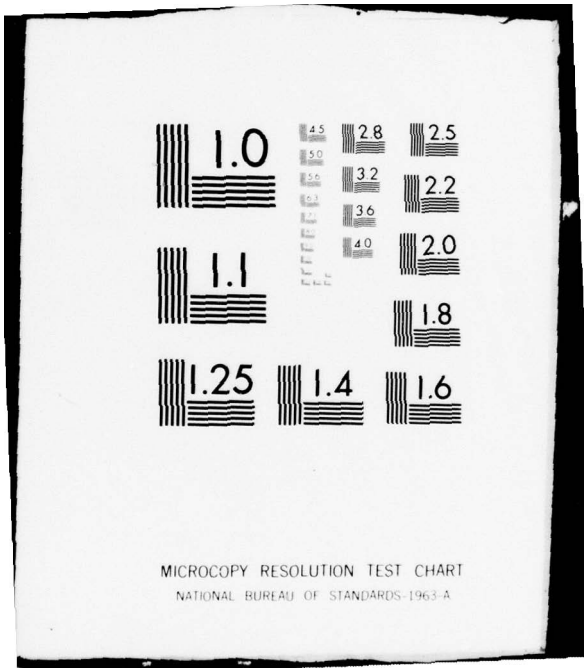
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LEVEL II

(1)

SUSQUEHANNA RIVER BASIN

BEAR GAP NO. 6

COMMONWEALTH OF PENNSYLVANIA

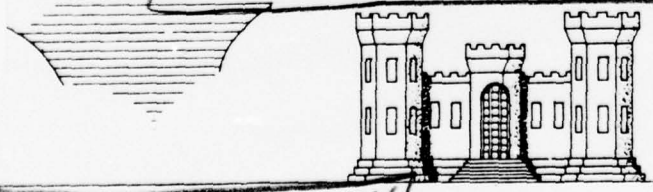
NORTHUMBERLAND AND COLUMBIA COUNTIES

INVENTORY NUMBER NDS PA. 817

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

National Dam Inspection Program. Bear Gap Number 6 (Inventory Number NDS PA 817), Susquehanna River Basin, Northumberland and Columbia Counties, Commonwealth of Pennsylvania. Phase I Inspection Report,



(15) DACW31-78-C-0044

Prepared For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland

by

BERGER ASSOCIATES, INC
CONSULTING ENGINEERS
HARRISBURG, PA.

(11) JULY 1978

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LEVEL II

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

The Bear Gap Dam no. 6 is an earthfill dam with a rock core which is founded on rock in a cut-off trench. It was completed in 1915.

Name of Dam: BEAR GAP NO.6

State & State Number: PENNSYLVANIA, 49-1

County Located: NORTHUMBERLAND AND COLUMBIA

Stream: SOUTH BRANCH ROARING CREEK, SUSQUEHANNA

Date of Inspection: June 13, 1978

Based on a visual inspection, past performance and available engineering data, the dam and its appurtenances appear to be in fair condition. The following recommendations are made:

1. The owner shall make a detailed hydrologic and hydraulic analysis for this dam and improve the spillway capacity to meet the requirements of this study.

2. The owner shall carefully monitor the seepage on the dam and take remedial action if seepage increases or if turbidity in the seepage water is discovered or if embankment sloughage would occur.

In accordance with the Corps of Engineers' evaluation guidelines, the spillway capacity is inadequate to pass the PMF (Probable Maximum Flood) without overtopping the dam. The spillway capacity is capable of passing only 34 percent of the PMF peak inflow and, therefore, it is considered to be seriously inadequate.

A formal surveillance and downstream warning system shall be developed by the owner to be used during periods of high precipitation.

Contract DACW 51-78-C-0044

Submitted By:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
PROFESSIONAL ENGINEER
HENDRIK JONGSMA
No 5557E

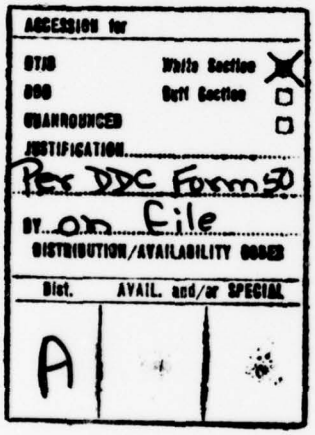
Date: July 31, 1978

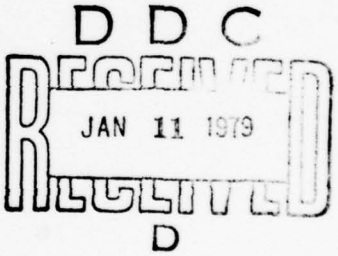
BEAR GAP NO. 6 DAM

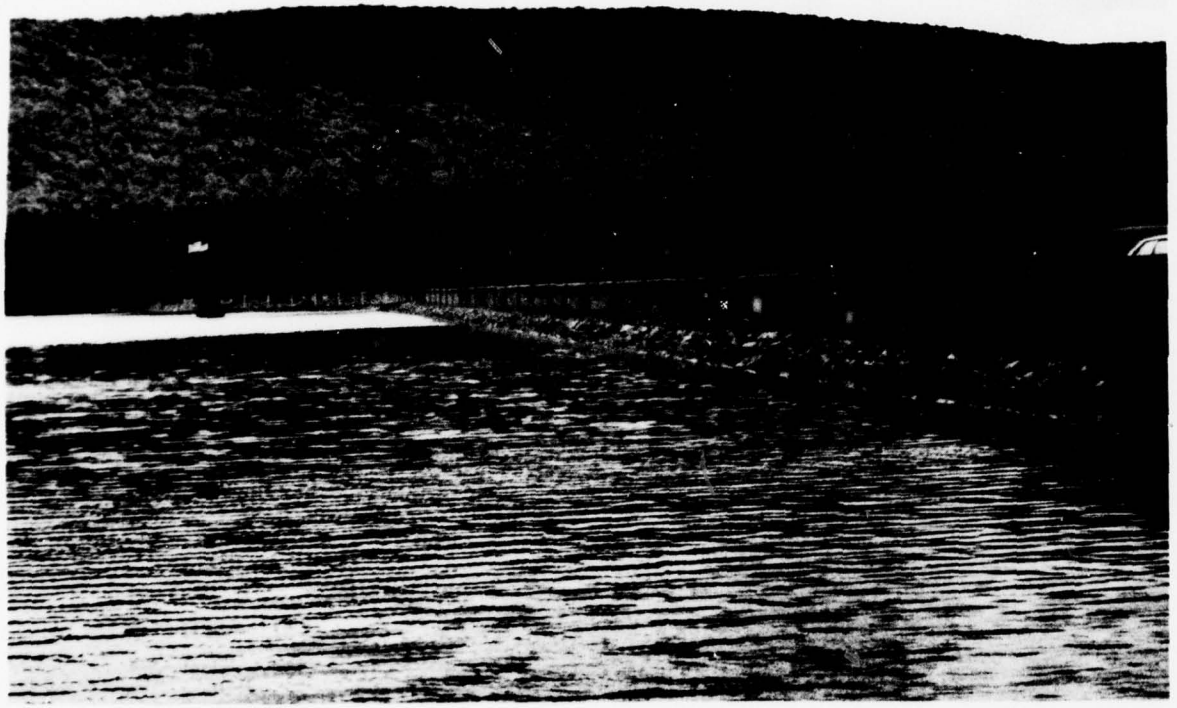
APPROVED BY:

31 JUL 78

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer







OVERVIEW
LOOKING SOUTH

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States. The Phase I Inspection and Report are limited to a review of available data, a visual inspection of the dam site and basic calculations to determine the hydraulic adequacy of the spillway.

B. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

The Bear Gap No.6 Dam is an earthfill dam with a concrete core, which is founded on rock in a cutoff trench. The length of the embankment is 1,540 feet and the maximum structural height is 70 feet. In 1924, the original dam was raised approximately 16 feet to its present height. The concrete core wall was extended upwards and a 3 feet high parapet was placed on the core wall above the embankment. The spillway is located at the right (north) end of the embankment and has an 82 foot long ogee section. The spillway chute was heavily damaged in 1972 (Agnes) and has been reconstructed. Appendix D, Plates III through VII show reproductions of photographs and details of this dam. Bear Gap No.2 Dam is located 4.4 miles downstream from this dam, and Lake Kline is 3.2 miles upstream. All these dams are owned by the same company.

B.	Location:	Mount Carmel Township, Northumberland County & Cleveland Township, Columbia County. U.S. Quadrangle, Mount Carmel, Pa. Latitude 40°-50.0', Longitude 76°-25.2' (Appendix D, Plates I and II)
C.	Size Classification:	Intermediate (height 60 feet).
D.	Hazard Classification:	High (see Section 3.1.E).
E.	Ownership:	The Roaring Creek Water Company 204 East Sunbury Street Shamokin, Pennsylvania 17872

F. Purpose: Water Supply

G. Design and Construction History

The available data in the files of the Pennsylvania Department of Environmental Resources is very limited. The earliest information is dated May, 1912, in which reference is made to an application for raising the embankment and spillway. Photographs indicate that this construction was completed in 1915. In 1924, the embankment was raised another 19± feet to the present height and a new spillway constructed. The design and construction specifications were prepared by Gannett, Seelye and Fleming, Harrisburg, Pennsylvania. Appendix D, Plate VI, is a sketch indicating a typical section of the dam. During tropical storm Agnes in June, 1972, a considerable washout occurred in the spillway chute which consisted of stone paving. The damage started about 200 feet downstream from the ogee section. Repairs for the chute were designed by Gannett, Fleming, Corddry and Carpenter, Inc., and construction was completed in June, 1975.

H. Normal Operating Procedures

The impounded water is used for domestic water supply. This dam is owned by The Roaring Creek Water Company, a privately owned company. Water can be taken from the lake at different levels, with a flexible pipe.

1.3 PERTINENT DATA

A.	Drainage Area (square miles)	8.8
B.	Discharge at Dam Site (cubic feet per second) For hydraulic calculations see Appendix B	
	Maximum known flood at dam site	1,850
	Outlet tunnel low pool outlet at pool Elev. 1,023	50
	Outlet tunnel at pool Elev. 1,067	140
	Spillway capacity at pool Elev. 1,072 (top of earth fill)	3,000
	Spillway capacity at pool Elev. 1,075 (top of parapet)	6,100
C.	Elevation (feet above mean sea level)	
	Top of 3-foot high parapet	1,075

Top of earth fill	1,072
Spillway crest	1,067
Upstream portal invert of outlet tunnel	1,020
Downstream portal invert of outlet tunnel	1,016
Streambed at centerline of dam (Estimated)	1,015
Maximum tailwater (Estimated)	1,015

D. Reservoir (miles)

Length of maximum pool	1.9
Length of normal pool	1.5

E. Storage (acre-feet)

Normal pool (Elev. 1067)	3,980
Top of embankment (Elev. 1072)	4,960
Top of parapet (Elev. 1075)	5,600

F. Reservoir Surface (acres)

Top of parapet	218
Top of embankment	206
Normal pool	185

G. Dam

For a typical section see Appendix D, Plate VI.

Type: Rolled earthfill with concrete core.

Length: 1,540 feet.

Height: 70 feet above core wall foundation.

Top Width: 32 feet, including a 2-foot parapet.

Side Slopes: Upstream - 2H to 1V above Elev.1050
2.5H to 1V below Elev.1050
Downstream - 2H to 1V

Zoning: Concrete core wall extending 3 feet above embankment.

Cutoff: Concrete core wall (maximum width 8 feet).

Grout Curtain: Included in specifications for the 1924 extension of cutoff wall. Unknown for the older section.

H. Regulating Tunnel

Type: 30-inch diameter cast iron pipe

Length: Estimated - 300 feet

Closure: Gate valve in intake tower and gate valve in gate house at downstream toe of dam.

Access: Bridge from breast of dam to intake tower. Gate house at toe of dam is at grade.

Regulating Facilities: Manually operated valves as noted above.

I. Spillway

Type: Modified ogee with vertical upstream face and flat top (see Sheet 1 of Appendix B).

Length of weir: 81.5 feet.

Crest elevation: 1,067 feet on owner's plans (USGS topo map shows 1068).

Upstream channel: Spillway is at right end of dam. Approach channel is wide open and appears to have an upward slope of about .5 percent. At the upstream side of the weir, the channel is about 2 feet deep at normal pool stage.

Downstream channel: The spillway chute was destroyed by the 1972 flood and it has since been rebuilt with several arrangements of concrete channels and steel sheet piling cells. It now has a total length of about 1,400 feet. Starting at the bottom of weir crest there is about 120 feet of gentle slope, a 10-foot drop to a bucket, a second 10-foot sloping drop with staggered concrete baffles, a 1000-foot concrete channel which is almost level, and then a final 10-foot sloping drop with staggered concrete baffles.

J. Regulating Outlets

Low flow inlet to outlet conduit with invert elevation of about 1020.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Data Available

1. Hydrology and Hydraulics

The files of Pennsylvania Department of Environmental Resources (PennDER) did not contain any hydrologic or hydraulic information. There was no Permit Application Report on file for the raising of the dam in 1912 or in 1924. A letter dated 1926, reports that the spillway was designed for 650 cfs per square mile.

2. Embankment

The files of PennDER did not contain any drawings for the construction of this dam. The owner has in his office a set of drawings with some details of the raising in 1924, and referred us to Gannett, Fleming, Corddry and Carpenter, Inc., his consultant. Plate VI in Appendix D is a sketch of the information obtained in the owner's office. PennDER's files contained the specifications for the 1924 raising of the dam.

3. Appurtenant Structures

Design criteria and design calculations for the appurtenant structures were not available in the PennDER files. Construction photographs show the excavated trench for the cutoff trench and a photograph taken in 1938 indicate that the spillway waste channel extension was constructed with hand laid riprap. Design drawings for the reconstruction of the spillway chute are in the PennDER files.

B. Design Features

1. Embankment

The material used for the embankment during the raising in 1924 was to be spread in layers not exceeding 8 inches, and each layer was to be harrowed, cleared of stones larger than 6 inches and rolled. Each layer was to be watered if deemed necessary. The extension of the core wall was to be placed in a trench excavated through the permeable strata. Drill holes at 6 foot centers and 25 feet deep were to be grouted under 60 lbs. per square inch pressure. After placing the concrete cutoff wall, the trench was to be backfilled in six-inch layers. The wall was constructed with expansion joints at 30-foot centers.

2. Appurtenant Structures

In 1924 a new spillway was constructed and a concrete arch bridge was constructed across the spillway just below the ogee weir. The top of the old intake structure was removed and a new concrete extension was constructed. The actual gatehouse was built of rubble stone on the concrete extension. A new valve house at the downstream toe was constructed in 1924 and rubble stone masonry was used for its construction.

C. Design Data

1. Hydrology and Hydraulics

PennDER's files did not contain any hydrologic or hydraulic design data except that a letter stated that the spillway had been designed for a discharge of 5,700 cfs.

2. Embankment

PennDER's files did not include design data or design criteria for the embankment. There was no indication of borings, test pits or a geological report.

3. Appurtenant Structures

Design criteria or design data for the appurtenant structures were not available for review.

2.2 CONSTRUCTION

The available construction data consisted of the construction specifications for the raising in 1924 and some construction photographs. The specifications and the plans, in the owner's office, referred to a two-span concrete encased steel beam bridge across a 75-foot wide spillway. This design was changed to a single concrete arch bridge across an 81.5 foot wide spillway.

2.3 OPERATION

The purpose of the dam and appurtenant structures is to supply domestic water. Formal records of operation were not available for review.

2.4 EVALUATION

A. Availability

The only available design data in PennDER's files consisted of construction specifications and construction photographs. The owner has

a set of blue prints with design details of the raising of the dam in 1924.

B. Adequacy

1. Hydrology and Hydraulics

Design criteria and data were not available in the files except a statement that the spillway was designed for 5,700 cfs.

2. Embankment

The description of embankment construction and a review of the typical section indicates that the embankment design was adequate.

3. Appurtenant Structures

There were no detailed design drawings in the files available for review.

C. Operating Records

No formal operating records were available for review. Tropical storm Agnes (June, 1972) caused an approximate discharge depth of 3.6 feet over the spillway weir. A considerable length of the spillway chute was washed away and 25 feet deep gullies were formed. On August 10, 1972, the owner was instructed to draw down the lake to 10 feet below normal pool elevation. This order was rescinded on May 11, 1976, after the wasteway channel was reconstructed.

D. Post Construction Changes

No reported modifications have been made to the embankment. After the washout in 1972 a steel sheet pile cell was constructed in 1973 across the spillway channel to prevent further progression of the gully. Additional construction on the spillway channel occurred in the next few years, consisting of energy dissipators and a new channel. Construction of these improvements was completed in May, 1975. Construction drawings and specifications for this reconstrustion are in the files of PennDER.

E. Seismic Stability

The dam is located in Seismic Zone 1 and it is considered that the static stability with normal safety factors is sufficient to withstand minor earthquake induced dynamic forces. No calculations or studies have been made to confirm this.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general outward appearance of the dam and appurtenant structures is good. The reservoir and embankment give a pleasant appearance and are well maintained. The visual checklist is in Appendix A. Photographs taken during the inspection are reproduced in Appendix D, Plates III, IV and V.

B. Embankment

The horizontal alignment of the dam is curved at the south end (left abutment). The top of the dam is 32 feet wide (Appendix D, Plate VI) and has a 3 foot high concrete parapet on the upstream side. The parapet appeared to be maintained in excellent condition. The upstream slope is protected by riprap and did not show any irregularities. The downstream slope has a good grass mat and is mowed at regular intervals. Some seepage and wet spots were detected during the inspection. See schematic plan in Appendix D for appropriate location. The amount of seepage was not considered excessive and no transportation of fines was noted. Mr. Douglas McWilliams, owner of the company, stated in a phone conversation that these areas dry out in the summertime.

C. Appurtenant Structures

The appurtenant structures all appear to be in good condition. An arch bridge is located across the spillway just below the ogee section (Appendix D, Plate IV). The spillway had been heavily damaged during tropical storm Agnes in June, 1972. The damage started about 200 feet downstream from the ogee section. The spillway chute was redesigned and construction was completed in 1975. Photographs on Plate IV and V show the new spillway channel and energy dissipators.

The intake structure is located on the upstream side of the dam and is accessible by a bridge. The structure was locked and could not be inspected. Mr. Sacona, representative of the Bear Gap Water Company, stated that there were three valves and that all valves are operated regularly. One intake pipe has a flexible end and can be raised or lowered with a chain to obtain the most desirable water quality. The blowoff pipe has a 30-inch gate. The valve house was in reasonably good condition and is easy accessible.

D. Reservoir Area

The reservoir area is very well kept. The lake is surrounded by woods and the lake banks did not show any erosion problems.

E. Downstream Channel

A new channel with a stone bed and dikes was constructed in 1973. There are two locations with steep drops and energy dissipators. Below the last drop structure the water enters the natural channel which is sufficiently wide and clear. The Bear Gap No.2 Dam (NDS #816) is about 4.4 miles downstream and just below that dam is the intake dam. Farther downstream several homes and farm buildings are located within the flood plain. Failure of this dam would cause overtopping and possible failure of Bear Gap No.2 Dam. Although no persons are living near the stream between the two dams, the successive failure of both dams would cause loss of life of more than a few and an appreciable economic loss. The hazard classification for this dam is considered to be "High".

3.2 EVALUATION

The observed condition of the embankment and appurtenant structures is considered to be good. The embankment is constructed with a concrete core wall but no records of a toe drain were found. Some seepage was apparent at two locations; one just beyond the downstream toe and one on the embankment slope. The amount of leakage was, however, not excessive and not considered to be serious at the time of inspection but could worsen with time. A regular inspection program to monitor this seepage should be implemented. The location of the arch bridge just below the ogee section could be restricting the spillway capacity and should be analyzed (see Section 5).

Personnel of the water company visit the site daily, although not all appurtenant structures are checked.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

This impoundment dam for water supply is one of several dams owned by the Bear Gap Water Company, Shamokin, Pennsylvania. The owner of the company owns a summerhouse and a hunting cabin close to the dam and the area is well maintained and supervised. The main purpose is to maintain the lake at the normal pool elevation of 1067. No specific procedures are in effect.

4.2 MAINTENANCE OF DAM

The area of the facilities is checked on a daily basis and is very well maintained. Although the grass on the downstream slope was rather high on the day of inspection, the owner's representative stated that the slope was mowed regularly.

4.3 MAINTENANCE OF OPERATING FACILITIES

According to Mr. Sacona, company representative, the valves are operated several times a year. The outside condition of the valve house was good, but the intake structure was locked and keys were not available. The valve operation was, therefore, not inspected.

4.4 WARNING SYSTEM

There is no formal warning system in effect.

4.5 EVALUATION

The general operational procedures are acceptable, except that no formal warning system is in effect. Regular operation of the blow-off valve should be encouraged.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analysis available from PennDER for Dam No.6 was not very extensive. No area-capacity curve, frequency curve, unit hydrograph, design storm, design flood hydrograph, nor flood routings were submitted by the designer to PennDER. The files did contain a 1926 letter from C. E. Ryder, of the Pennsylvania Water and Power Resources Board, which says that the spillway was designed to pass 650 cubic feet per second per square mile or a total of 5,720 cubic feet per second. Calculations made for this report give a total capacity of 6,100 cubic feet per second. (Assuming pool containment to top of parapet wall, elevation 1075, and that this wall is structurally capable of such containment - see Sheet No.8 of Appendix B). The "C" curve would require a capacity of 820 cubic feet per second per square mile or 7200 cfs.

A spillway rating curve and a reservoir area-capacity curve have been computed for this report (see Appendix B).

B. Experience Data

The owner furnished information about a high-water mark for the June, 1972 flood. Calculations made for this report indicate a discharge of 1,850 cubic feet per second for that flood. That discharge was sufficient to severely damage the spillway chute (see Appendix B).

C. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtopped. (There is a question as to the elevation at which the dam would be overtopped - see Sheet No.8 of Appendix B).

D. Overtopping Potential

Comparison of the estimated PMF peak inflow of 18,000 cfs, with the estimated ultimate spillway capacity of 6,100 cfs, indicates that the potential for overtopping of Dam No.6 exists.

An estimate of the storage effect of the reservoir shows that Dam No.6 does not have the necessary storage available to pass 1/2 PMF without overtopping (see Appendix B).

E. Spillway Adequacy

Bear Gap No.6 Dam has a size classification of "Intermediate" (60 feet high and a capacity of 5,600 acre-feet), and a hazard potential of "High". (Bear Gap No.2 Dam, which also has a hazard potential classification of "High", is about 4.4 miles downstream). These two classifications indicate a Recommended Spillway Design Flood (SDF) equal to the PMF.

Calculations made for this report indicate that Bear Gap No.6 Dam will be overtopped by the PMF and its spillway is, therefore, considered to be inadequate. Since these calculations further indicate that the dam will be overtopped by the 1/2 PMF, the spillway is considered to be seriously inadequate (See Appendix B, Sheets 5, 6 and 7).

The PMF peak flow for this site is 18,000 cfs and the ultimate spillway capacity is 6,100 cfs, or 34 percent of the PMF peak flow.

There are four dams in series on this stream. Starting at the top, they are: Lake Kline Dam, Bear Gap No.6 Dam, Bear Gap No.2 Dam, and Bear Gap No.1 Dam. Calculations indicate that the 1/2 PMF will overtop each of these dams regardless of the failure or non-failure of the remaining three.

Calculations made for this report indicate that the masonry arch bridge located 11 feet downstream from the spillway weir does not have any effect on the discharge rating of that weir (see Appendix B, Sheet 1).

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observation

1. Embankment

There were no visual indications of undue embankment stresses or sloughage. Except for a small amount of seepage near the left abutment just above the roadway leading to the valve house (Appendix D, Plate VII) the embankment was in good condition. A small amount of leakage was also detected about 50 feet beyond the toe of the dam, north of the valve house and located in a wooded area.

2. Appurtenant Structures

Visual observations indicate no present stability or stress problems in any of the appurtenant structures. A small amount of spalling has occurred on the spillway walls near the spring line of the arch bridge.

B. Design and Construction Data

1. Embankment

There were no design criteria or design data available for review. The typical section shown on Plate VI, Appendix D, indicates a well engineered section with a concrete core wall extending to rock surface. The specifications for the 1924 raising of the dam specified a good contact with the rock strata and that grouting was to be used. All structures appear to be in good condition, indicating good construction.

2. Appurtenant Structures

The original stone spillway channel was washed out in 1972 and was replaced with new construction. The abutment walls of the spillway weir appear to be stable and well founded. No specific design data were available for review of the spillway weir or intake structure.

C. Operating Records

No formal operating records were available for review. The only reported major problem occurred in 1972 during the Agnes storm when considerable damage occurred to the spillway chute. Damage started at a point 200 feet downstream from the weir and did not encroach on the embankment.

D. Post Construction Changes

The only reported modifications made to the original dam and appurtenant structures consisted of reconstruction of approximately 1,000 feet of spillway channel, starting about 200 feet downstream from the spillway weir. This reconstruction included two sets of energy dissipators shown on Plates V and VIII, Appendix D.

E. Seismic Stability

This dam is located in Seismic Zone No.1 and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations, studies, etc., were made to confirm this conclusion.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection, the review of available design data and the operational history indicates that the dam is in good condition and has been constructed in accordance with acceptable engineering practice.

The main concern is the spillway capacity which is 34 percent of the PMF peak inflow and is considered to be seriously inadequate.

B. Adequacy of Information

Although the available information was limited, it is considered adequate to make a reasonable assessment of the project.

C. Urgency

The recommendations made in this section should be implemented as soon as possible.

D. Necessity for Additional Studies

Additional studies are required as outlined in the recommendations listed in this section.

7.2 RECOMMENDATIONS

A. Facilities

In order to assure continued satisfactory operation of this dam, the following recommendations are made:

1. The owner shall make a detailed hydrologic and hydraulic analysis for these facilities and improve the spillway capacity to meet the requirements found by this analysis.

2. The owner shall monitor the seepage occurring at this dam. If seepage increases or if turbidity is discovered in the seepage water, or embankment sloughage is detected, immediate remedial measures shall be taken.

B. Operation and Maintenance Procedures

It is considered important that a formal surveillance and downstream warning system be developed to be used during periods of high precipitation.

APPENDIX A

VISUAL INSPECTION

CHECK LIST - DAM INSPECTION PROGRAM

PHASE I - VISUAL INSPECTION REPORT

NAD NO. 817

PA. ID # 49-1 NAME OF DAM Bear Gap No.6 HAZARD CATEGORY Significant

TYPE OF DAM: Earthfill

LOCATION: Mount Carmel / Cleveland TOWNSHIP Northumberland / Columbia COUNTY, PENNSYLVANIA

INSPECTION DATE 6/13/78 WEATHER Cloudy - Cool TEMPERATURE 50's

INSPECTORS: H. Jongsma, R. Houseal
A. Bartlett, R. Staecy

For Bear Gap Water Co.
Field: Harry Sacona
Office: Douglas McWilliams

NORMAL POOL ELEVATION: 1067 AT TIME OF INSPECTION:

BREAST ELEVATION: 1072 POOL ELEVATION: 1067.25
Parapet 1075
SPILLWAY ELEVATION: 1067 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: 1070.5 - June, 1972 (Agnes)

GENERAL COMMENTS:
The dam has a pleasant appearance and the surrounding area is well kept.

The parapet wall across the entire top of the dam shows signs of age (54 years). Weathering and normal deterioration of the concrete is visible. Maintenance care has patched much of the major deterioration.

Top of the parapet is elevation 1075.±
Length of dam, not including spillway, is 1540 feet.
Spillway length is 82 feet.

DAM NO. NAD 817

VISUAL INSPECTION

EMBANKMENT	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. SURFACE CRACKS	None	
B. UNUSUAL MOVEMENT BEYOND TOE	None evident	
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None evident	
D. VERTICAL & HORIZONTAL ALIGNMENT OF CREST	No obvious vertical misalignment or settlement. Horizontal alignment curved by design	
E. RIPRAP FAILURES	None evident	
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Junctions appear sound at all areas of jointure.	
G. SEEPAGE	Seepage observed near the toe of the downstream slope carrying beyond and below toe. Describe as slight - no steady flow - area is wet and soggy however.	
H. DRAINS	No toe drain.	
J. GAGES & RECORDER	None	
K. COVER(GROWTH)	Upstream - Rip Rap Top of Dam - grassed with stone wheel tracks. Downstream - tall grass.	

DAM NO. NAD 817

VISUAL INSPECTION

OUTLET WORKS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. INTAKE STRUCTURE	Locked - could not inspect. Owner's Rep. indicates 3 pipes; one flexible	
B. OUTLET STRUCTURE	Valve House 14" & 18" from intake 30" blowoff valve	
C. OUTLET CHANNEL	Small concrete structure Seldom used for blowoff	
D. GATES	14" & 18" valves. 30" gate valve for blowoff.	
E. EMERGENCY GATE	30" blowoff valve	
F. OPERATION & CONTROL	Minimal	
G. BRIDGE (ACCESS)	Bridge to intake structure from breast of dam.	

DAM NO. NAD 817

VISUAL INSPECTION

SPILLWAY	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. APPROACH CHANNEL	Directly from the lake	
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Ogee - 82'± in length No major distress Normal - no apparent spalls Walls show some spalling	
C. DISCHARGE CHANNEL Lining Cracks Stilling Basin	Concrete training walls below stone walls, then new concrete walls. Concrete apron, then stone bottom channel to vertical drop into stilling basin - sheet piling and concrete walls with sloping chute to channel New construction see F.	
D. BRIDGE & PIERS	Arch bridge over spillway channel Spillway, bridge and concrete walls appear to be a continuous structure.	
E. GATES & OPERATION EQUIPMENT	None	
F. CONTROL & HISTORY	Heavily damaged in 1972 - new spillway chute and channel.	

DAM NO. NAD 817

VISUAL INSPECTION

MISCELLANEOUS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
INSTRUMENTATION		
Monumentation	None	
Observation Wells	None	
Weirs	None	
Piezometers	None	
Other	--	
RESERVOIR		
Slopes	Upstream - wooded around lake	
Sedimentation	No record	
DOWNSTREAM CHANNEL		
Condition	Natural stream	
Slopes	Wooded	
Approximate Population	15	
No. Homes	5	

APPENDIX B

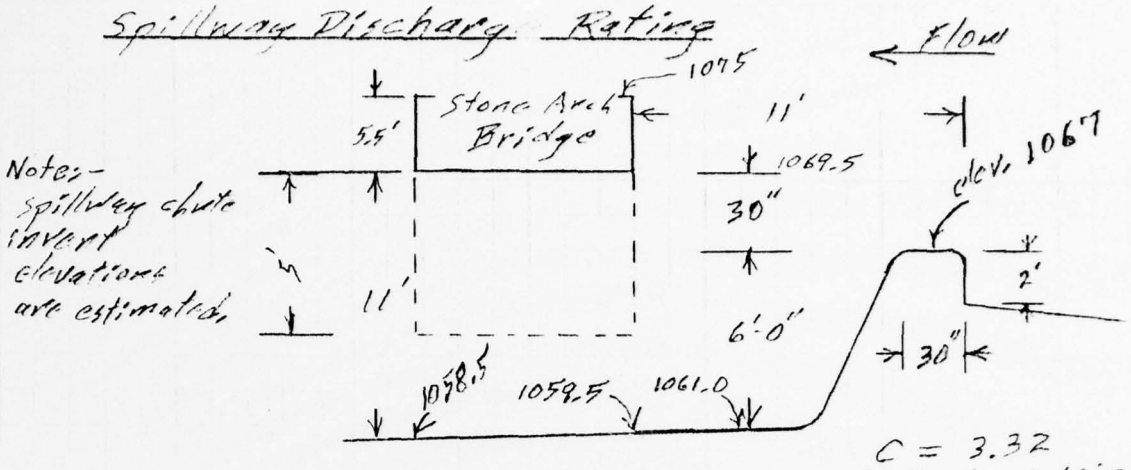
HYDROLOGY/HYDRAULICS

PROJECT Dam Investigation SHEET NO. 1 OF 8

SUBJECT Dam No. 6, S. Fk. Roaring Creek - ID No. 817

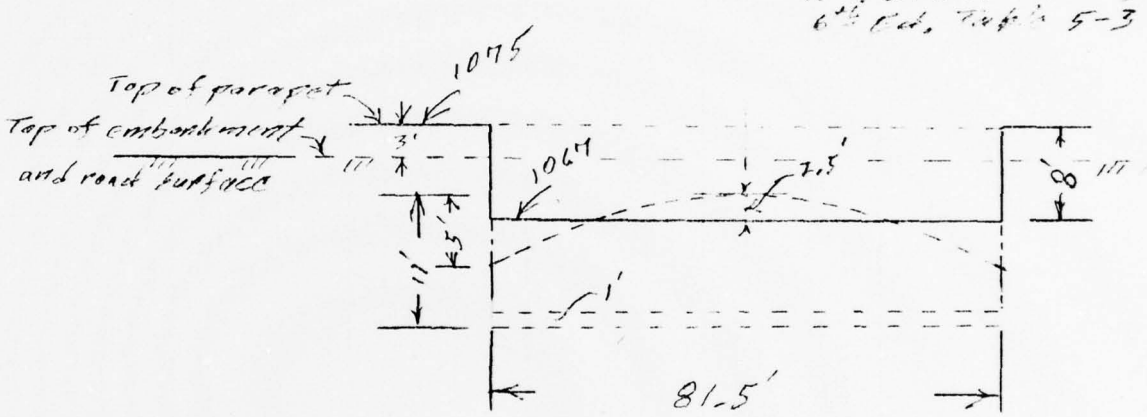
COMPUTED BY RES DATE 6-21-78 CHECKED BY JJP 6-27-78

Spillway Discharge Rating



Notes:- spillway chute invert elevations are estimated.

C = 3.32
Ref: Brater & King 6th Ed. Table 5-3



Pool at elev. 1075

$Q = CLH^{3/2} = 3.32 \times 81.5 \times (8)^{3/2} = 6{,}120$ cfs

Consider flow thru arch bridge. At pool elev. 1075 (top of parapet wall), bridge opening comprises flow over weir (6,120 cfs) with only 0.5 feet of submergence out of 8 feet of head. See sheets 2 and 3. It can be assumed that bridge has no effect on weir ratings.

Pool at elev. 1070

$Q = CLH^{3/2} = 3.32 \times 81.5 \times (3)^{3/2}$

$= 1{,}410$ cfs

Pool at elev. 1072 (Top of conc. sill)

$Q = CLH^{3/2} = 3.32 \times 81.5 \times (5)^{3/2}$

$= 3{,}030$ cfs

PROJECT: Dam Investigation
SHEET NO. 2 OF 2
SUBJECT: Dam No. 6, S. Br. Roaring Creek ID No. 817
COMPUTED BY: RES DATE: 6-22-78 CHECKED BY: JJP 6-28-78

<u>Centroid</u>

Area	h	Area × h
407.5	13.0	5298
76.0	10.0	760
64.0	9.0	576
51.0	8.0	408
36.0	7.0	252
18.0	6.0	108
652.5		7402

$\frac{7402}{652.5} = 11.34 = H$ to centroid.
From elev. 1075

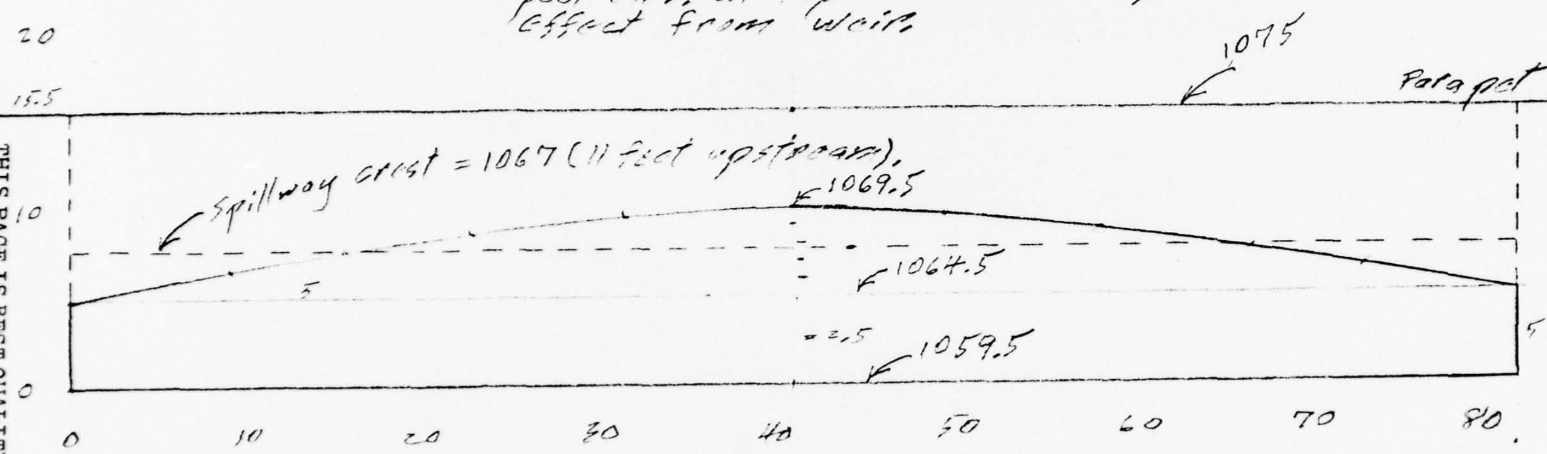
$Q = Ca\sqrt{2gh}$
$= 0.612 \times 652 \times$

$C = 0.612$
Ref. Brater + King, 6th Ed. Table 4-5

$Q = Ca\sqrt{2gh}$

$= 0.612 \times 652 \times (64.3 \times 11.34)^{1/2}$

$= 10{,}800$ cfs = Estimated Flow through bridge opening with pool elev. at top of dam (1075) and with no effect from weir.



SECTION AT
STONE ARCH BRIDGE.

Scale 1" = 10'

PROJECT Low Investigation SHEET NO. 1 OF 4

SUBJECT Dam No. 6, E. Fk. Poorman Creek ID No. 817

COMPUTED BY REE DATE 6-27-78 CHECKED BY JJP 6-28-78

Consider water level at top of arch (1069.5) and no effect from weir.

$Q = C a \sqrt{2gh}$

$= 0.612 \times 652 \times (64.3 \times 5.84)^{1/2}$

$= 399 \times (376)^{1/2}$

$= 7{,}740$ cfs

$C = 0.612$

$a = 652$

$h = 11.34 - (75 - 69.5)$

$= 5.84$

Consider water level at spring line of arch (1064.5). and no effect from weir.

$Q = C L H^{3/2}$

$= 2.63 \times 81.5 \times (5)^{3/2}$

$= 214 \times 11.2$

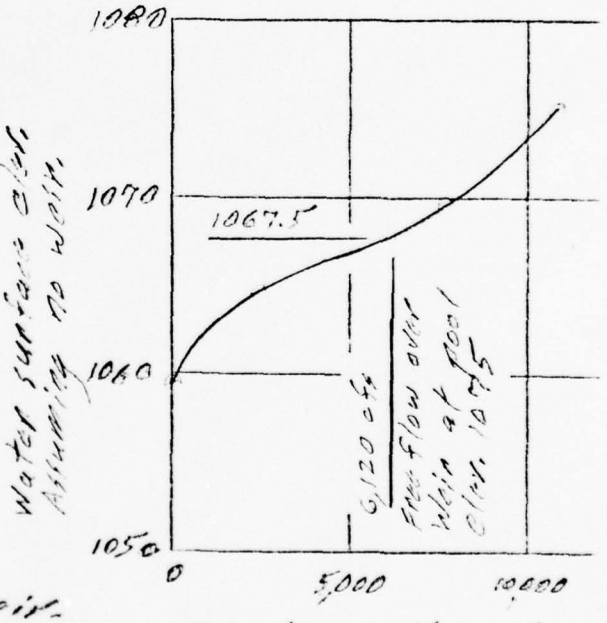
$= 2400$ cfs

$C = 2.63$

$L = 81.5$

$H = 5$

Graph at right shows elev. vs discharge rating for bridge opening, assuming no effect from weir. At maximum pool elev. 1075, discharge over weir would be 6120 cfs and head on weir would be 8 feet. (See sheet 6). For flow of 6120 cfs back water from bridge would be 1062.5 elev., or 0.5 ft submergence on weir. This would be 6.25 % and would have no effect on weir rating. Use weir rating directly. (See sheet 4)



PROJECT Dam Safety Prog. SHEET NO. 20 OF

SUBJECT Bear Gap Dam No. 6 ID No. 917

COMPUTED BY RES DATE 7-25-78 CHECKED BY

Compute flow capacity of channel under masonry bridge as a check on possibility of submergence on weir.

See sketch on sheet 1.

Elev. of spring line	1064.5
Elev. of channel bottom	1059.5
Depth of water	5.0

$$\text{Area} = \text{width} \times \text{depth} = 81.5 \times 5 = 407.5 \text{ ft}^2$$

$$r = \frac{407.5}{81.5 + 5 + 5} = 4.45 \text{ ft.}$$

Assume water surface slope = bottom slope = 0.02 from design engineers drawing.

$n = 0.035$ (hand placed cobblestones)

$$V = \frac{1.486}{n} \times r^{2/3} \times S^{1/2}$$

$$= \frac{1.486}{0.035} \times (4.45)^{2/3} \times (0.02)^{1/2}$$

$$= 42.5 \times 2.71 \times 0.141$$

$$= 16.2 \text{ ft/sec}$$

$$Q = VA = 16.2 \times 5 \times 81.5 = 6,600 \text{ cfs}$$

Calculated maximum weir $Q = 6,120$ cfs (see sheet 1)

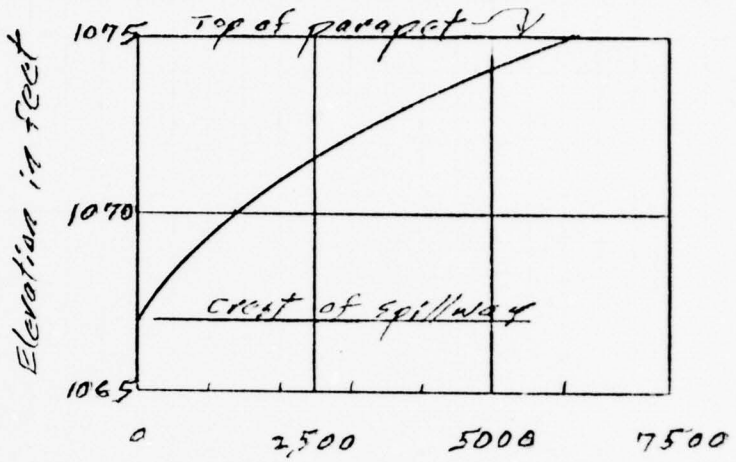
Channel will not cause submergence on weir.

PROJECT Dam investigation SHEET NO. 4 OF 5

SUBJECT Dam No. 6, S. Br. Roaring Creek, ID No. 817

COMPUTED BY REG DATE 6-27-78 CHECKED BY JJP 6-28-78

Spillway Discharge Rating, (cont.)



Spillway discharge rating

Maximum known flood at damsite.

Mr. Douglas McWilliams, owner of water company has a high-water mark from the June 1962 flood on his boathouse. His calculations indicate maximum pool elevation was 1067 + 3.6 = 1070.6

Discharge would be

$$3.32 \times 81.5 \times (3.6)^{3/2} = 1{,}850 \text{ cfs.}$$

Outlet tunnel at low pool. (elev. 1023)

There is an intake tower about 30 ft upstream from ℄ of dam with access by bridge. There is also a stone gate house at downstream toe of dam. Water may be released through a 30-inch cast iron pipe. There is also a 24-inch C.I. pipe which is a supply pipe to domestic water supply system. Estimate length of 30-inch pipe to be 300 feet. Upstream invert elev. is 1020. Downstream invert elev. is 1016.

$$V = \frac{0.590}{n} \times d^{2/3} \times S^{1/2}$$

$$= 39.3 \times (2.5)^{2/3} \times (0.0192)^{1/2}$$

$$= 39.3 \times 1.84 \times 0.139$$

$$= 10 \text{ ft/sec.}$$

$n = 0.015$

$d = 2.5$

$S = \frac{1023 - 1017.25}{300}$

$= 0.0192$

$Q = AV = \pi \times 1.5^2 \times 10 = 71 \text{ cfs.}$ Use 50 cfs.

SUBJECT Dam No. 6, S. Br. Hoaring Creek, ID No. 817

COMPUTED BY RES DATE 6-22-78 CHECKED BY: JJP 6-28-78

Outlet tunnel at pool elev. 1067.

$$V = \frac{0.590}{n} \times d^{2/3} \times s^{1/2}$$

$$= \frac{0.590}{0.015} \times (2.5)^{2/3} \times (0.166)^{1/2}$$

$$= 39.3 \times 1.84 \times 0.407$$

$$= 29.4 \text{ ft/sec.}$$

$$Q = AV = \pi \times (1.25)^2 \times 29.4$$

$$= 144 \text{ cfs} \quad \text{use } 140 \text{ cfs}$$

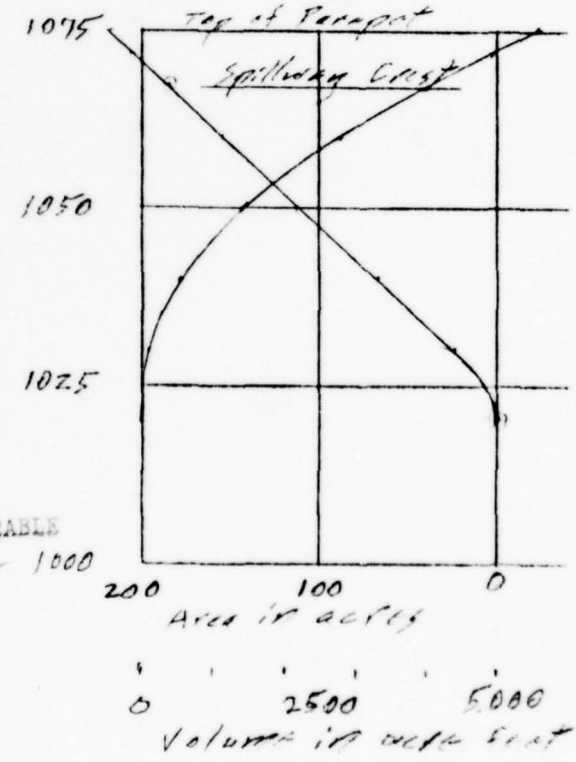
$n = 0.015$

$d = 2.5$

$s = \frac{1067 - 1017.25}{300} = 0.166$

Area and capacity curves

Elev.	Area acres	Vol. ac.ft.	Total Vol ac.ft.
1020	0	115	0
1030	23	450	115
1040	67	895	565
1050	112	1335	1460
1060	155	1170	2795
1067	185	978	3985
1072	206	636	4963
1075	218		5599



Overtopping Potential

PMF Susquehanna River Basin - Region 2

2,050 cfs/sq. mi.

8.8 × 2050 = 18,000 cfs.

From PMF relation curve furnished by the Baltimore Dist., Corps of Eng.

PROJECT Dam Investigation SHEET NO. 4 OF
SUBJECT Dam No. 6, S. Br. Roaring Creek, ID No. 817
COMPUTED BY RES DATE 7-3-78 CHECKED BY JJP 7-5-78

Overtopping Potential (cont.)
PMF (cont.)

Technical information about Lake Kline Dam which is 3.2 miles upstream from Dam No. 6, is not available. The following estimate of the hydraulic parameters for Kline Dam and Lake are based on information obtained from the USGS topo sheet and on the assumption that the construction is similar to Dam No. 6 *

Drainage Area 4.77 sq. mi. (Quad sheet)
Surface Area 32.1 acres (Quad sheet)
Vert. Dist. weir crest to top of dam 5 feet.
Max. spillway Q, pool at top of dam 2000 cfs
Total height of dam 21 feet
Total volume to top of dam 250 acre feet.
Volume, weir crest to top of dam 125 acre feet.

Lake Kline inflow $= \left(\frac{4.77}{8.8}\right)^{0.8} \times 18{,}000 = 11{,}000$ cfs.

25" runoff $= 53.33 \times 25 \times 4.77 = 6360$ ac. ft.

$\frac{\text{Max Spillway Q}}{\text{Peak Inflow}} = \frac{2000}{11{,}000} = 0.18$.

$\frac{\text{Req. Resv. Storage}}{\text{Vol of Inflow}} = 0.82$. From short cut routing method furnished by Balt. Dist. C of E.

Req. Resv. Stor. $= 0.82 \times 6360$
$= 5220$ acre ft.
Available stor. $= 125$ acre ft.
Lake Kline Dam will be overtopped.
Lake Kline outflow at least 11,000 cfs.
Volume $= 6360 + 125 = 6480$ ac. ft.
Dam No 6 inflow - assume Lake Kline has no effect. or PMF inflow to Dam No. 6.
Q $= 18{,}000$ cfs.
Vol $= 2.6" = 53.33 \times 26 \times 8.8 = 12{,}200$ acre feet.
$\frac{\text{Max Spillway Q}}{\text{Peak inflow}} = \frac{6120}{18{,}000} = 0.34$.
$\frac{\text{Req. Resv. Storage}}{\text{Vol. of Inflow}} = 0.66$

Req. Resv. Storage $= 0.66 \times 12{,}200 = 8050$ ac. ft.
Available Storage $= 5599 - 3985 = 1614$ ac. ft.
Dam No. 6 will be overtopped by PMF.

1/2 PMF $= 9{,}000$ cfs.
Lake Kline inflow $= 5{,}500$ cfs.
$= 12.5" = 3180$ acre feet.

* See note on sheet 7 for additional data on Lake Kline.

PROJECT [illegible] SHEET NO. [illegible] OF

SUBJECT Dam No. 6, S. Br. Roaring Creek, ID No. 817

COMPUTED BY REE DATE 7-3-78 CHECKED BY JJP 7-5-78

½ PMF (cont.)

$\frac{\text{Max Spillway Q}}{\text{Peak Inflow}} = \frac{2,000}{5,500} = 0.36$

$\frac{\text{Req. Resv. Stor.}}{\text{Vol of Inflow}} = 0.64$

Req Resr. Stor = $0.64 \times 3,180 = 2040$ ac. ft.

Avail. Stor. = 125 ac. ft.

Lake Kline Dam will be overtopped by ½ PMF.

Dam No. 6 inflow – assume Lake Kline failure has no effect on ½ PMF inflow to Dam No. 6

Q = 9,000 cfs.

Vol. = 13" = $53.33 \times 13 \times 8.8 = 6,100$ acre feet.

$\frac{\text{Max Spillway Q}}{\text{Peak inflow}} = \frac{6120}{9,000} = 0.68$

$\frac{\text{Req. Resr. Stor}}{\text{Vol of inflow}} = 0.32$

Req. Resv. Stor. = $0.32 \times 6100 = 1,952$ ac. ft.

Available Stor. = 1,614 ac. ft.

Dam No. 6 will be overtopped by ½ PMF.

Note – Lake Kline data from Pa DER Bull. No. 5, Water Resources Inventory No. 1. 1970.

Type – Earth Fill
Use – Water Supply
Class – Low Hazard
Height – 21 Feet.
Vol. – 41 MG (125 acre feet) to spillway crest.
Area – 24 acres
Drainage Area – 4.6 square miles.

Spillway Adequacy

Size Classification

Storage – 5,600 acre feet
Height – 60 feet.
These dimensions indicate a size classification of "Intermediate"

Hazard Potential Classification

Use "High"
See Section 3.1.c of text of report.

PROJECT _____ SHEET NO. _____ OF _____

SUBJECT Dam No. 6, E. Fk. Poe Creek, I.D. No. 817

COMPUTED BY RES DATE 7-3-78 CHECKED BY JP 1-5-78

Recommended Spillway Design Flood (SDF).

The above classifications indicate the SDF should be in the range ½ PMF to PMF.

Since the spillway can only pass 68 % of ½ PMF it is considered to be seriously inadequate.

Data from design engineer for spillway repairs.

The June 1972 flood destroyed all but the top 200 feet of the spillway chute. After the flood, the engineering firm of Barnett Fleming Cauddery & Carpenter Inc was engaged to design a new spillway chute which has now been built.

The design flow used by that firm was made available for this investigation after the above calculations were completed. The figures were given by Mr. Pickering from memory and may not be exactly correct. It was Mr. Pickering's opinion that the maximum pool elevation would be about 6 to 8 feet above the parapet or about 1072.6. He feels that above that elevation water will flow around the ends of the dam and probably cause failure. This situation was not evident to members of this investigating party and if it is recommended that the question be settled in a subsequent study.

Mr. Pickering recalls that his firm calculated the June 1972 flood peak to be 2,200 cfs at a pool elevation of 1072.6. He recalls that the new spillway chute was designed for a flow of 2,000 cfs. The owner of the dam gave a June 1972 flood peak elevation of 1070.6 which has been calculated to give a peak discharge of 1,850 cfs.

APPENDIX C

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Mauch Chunk Formation.

Lithology: Grayish red and reddish brown sandstone interbedded with similarly colored siltstone, mudstone and shale. Some thin interbeds of green to grayish green mudstones are common. Cement in the sandstones consists of hematite and silica.

Structure

The dam is located on the north limb of the complex syncline which forms the Western Middle Anthracite Coal Field. The beds strike N80°E and dip about 45°S, on the average. Local folds are possibly present, but are not mapped as there are almost no bedrock exposures in the valley of Roaring Creek.

There are a number of faults known to offset the crest of Little Mountain on the north side of the valley. None are mapped in the vicinity of the dam.

Fracture traces have the following trends: N43°E, N15°-20°E, N-S, N5°-10°W, N15°W and N35°W.

Overburden

This is an old dam and no foundation information is in the file. The spillway was damaged in 1972, and some core boring was done in preparation for repairs. Bedrock was encountered, in one hole, at 36 feet, but some, or all, of the material above bedrock was part of the dam embankment. The bedrock was logged as light brown sandstone and greenish brown shale. The color of the sandstone indicates that it has been somewhat weathered.

The absence of bedrock outcrops in the valley indicated that there probably is a cover of ten feet, or more, of overburden.

Aquifer Characteristics

While some of the sandstone units in the Mauch Chunk formation may have some primary porosity and permeability, most, or all, ground water movement is along bedding planes and fractures. Since the

grains and cement of the rock are essentially insoluble minerals, there is little chance of enlargement of fracture openings by ground water movement.

Discussion

Ground water movement in the Mauch Chunk Formation is probably principally along bedding. Since this dam is built at right angles to bedding strike, it is possible for ground water to move fairly easily under the dam in the bedrock. There is, little chance of enlargement of openings by ground water movement. The overburden and weathered zone of the bedrock are more permeable. If these were not cleared off sufficiently, or insufficiently grouted, there is a possibility of leakage. However, no leakage was reported after tropical storm Agnes in 1972.

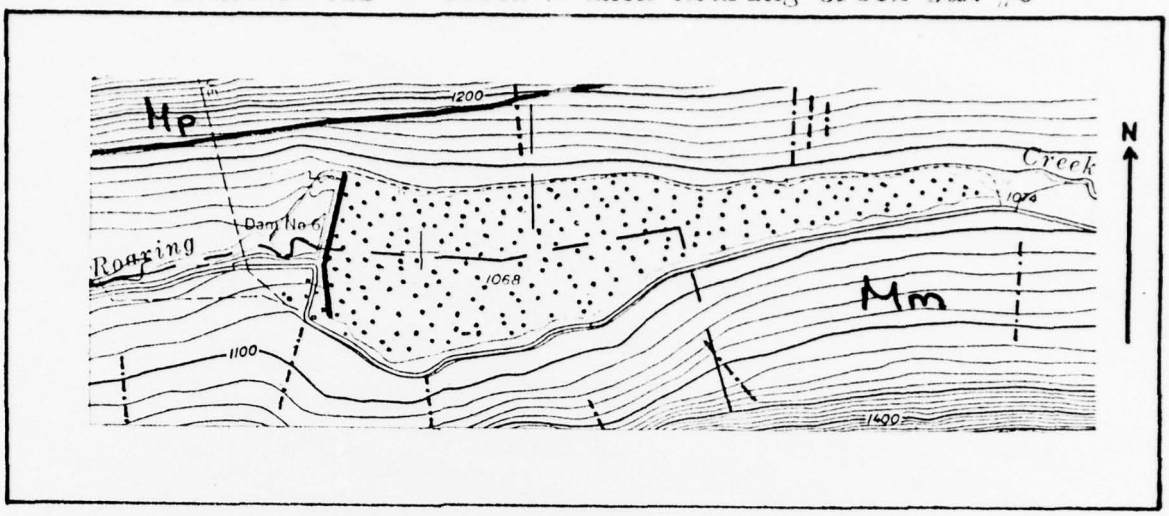
Sources of Information

1. Arndt, H.H., 1971 "Geologic Map of the Mt. Carmel Quadrangle" U.S. Geological Survey Map G.Q. 99.

2. Air Photographs, scale 1:24,000, dated 1969.

3. Core borings, file information, 1972.

GEOLOGIC MAP - South Branch Roaring Creek Dam #6



(geology from U.S. Geol. Surv. map GQ-919)

KEY

Mm — Mauch Chunk Fm- middle & lower member undifferentiated

Mp — Pocono Fm

air photo fracture trace

SCALE 1:24 000

1 0 1 MILE

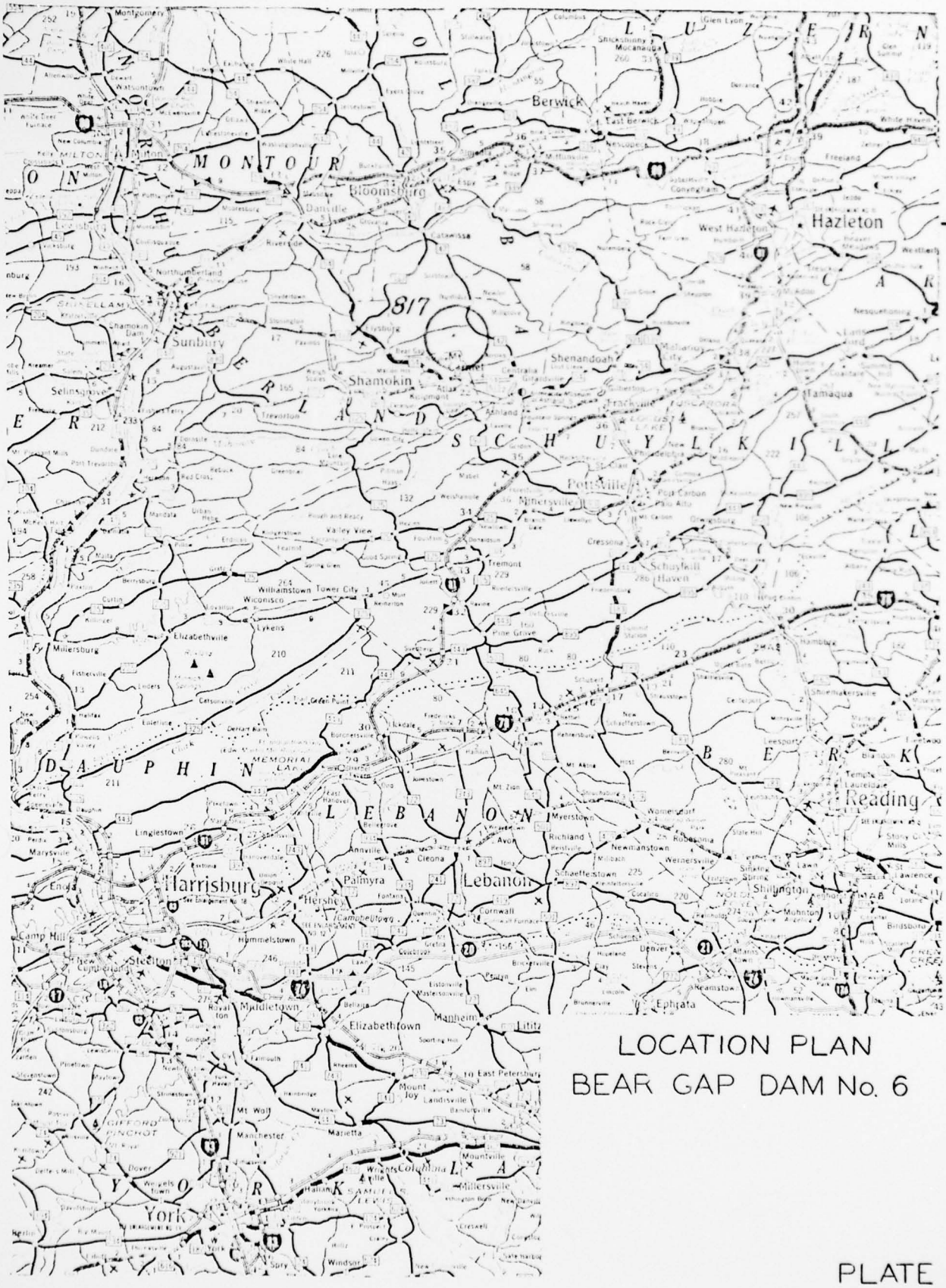
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

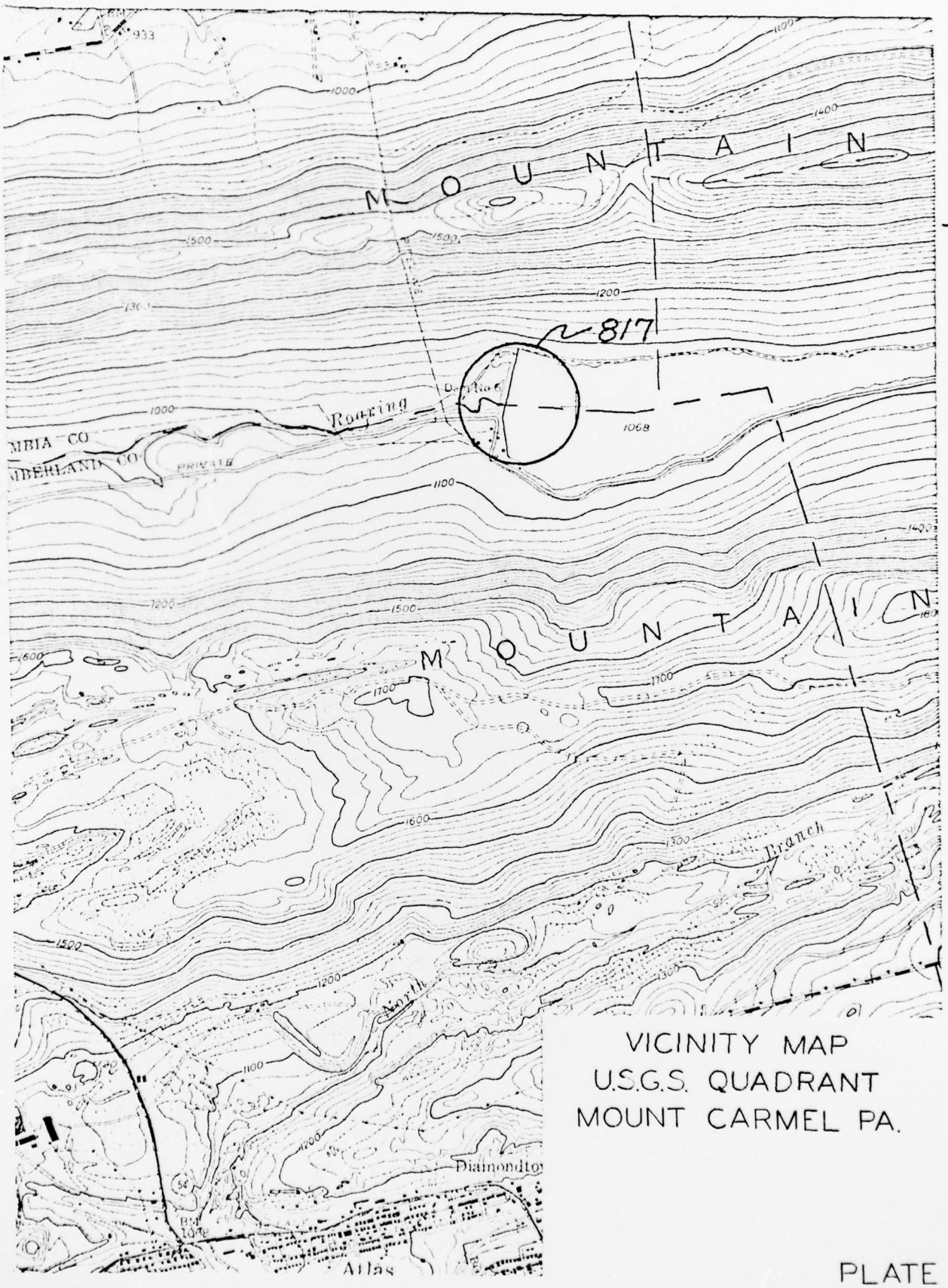
APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS



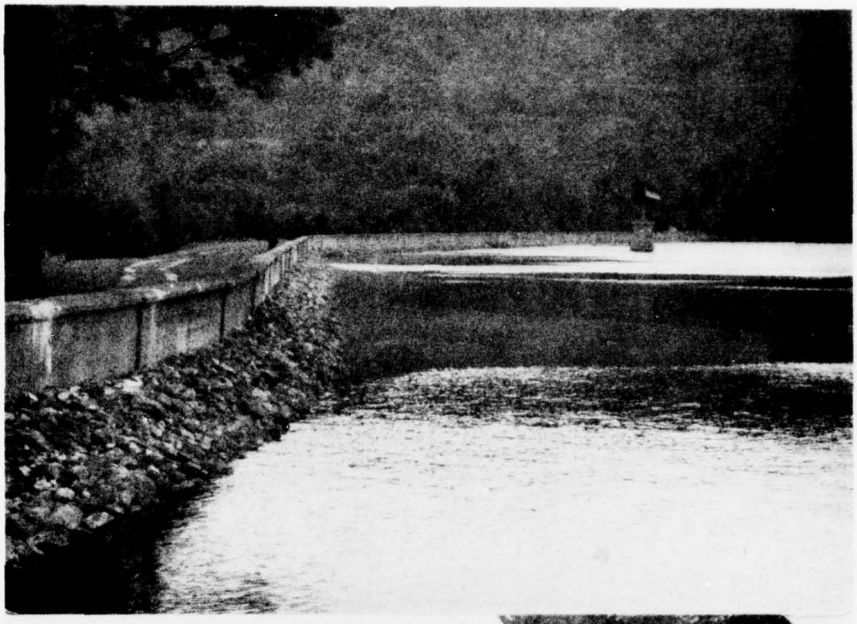
LOCATION PLAN
BEAR GAP DAM No. 6

PLATE I



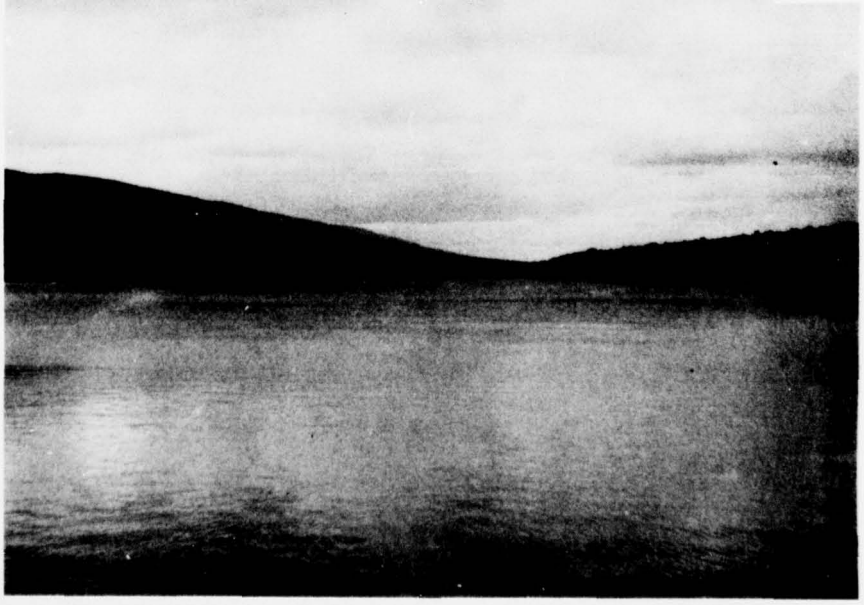
VICINITY MAP
U.S.G.S. QUADRANT
MOUNT CARMEL PA.

PLATE II



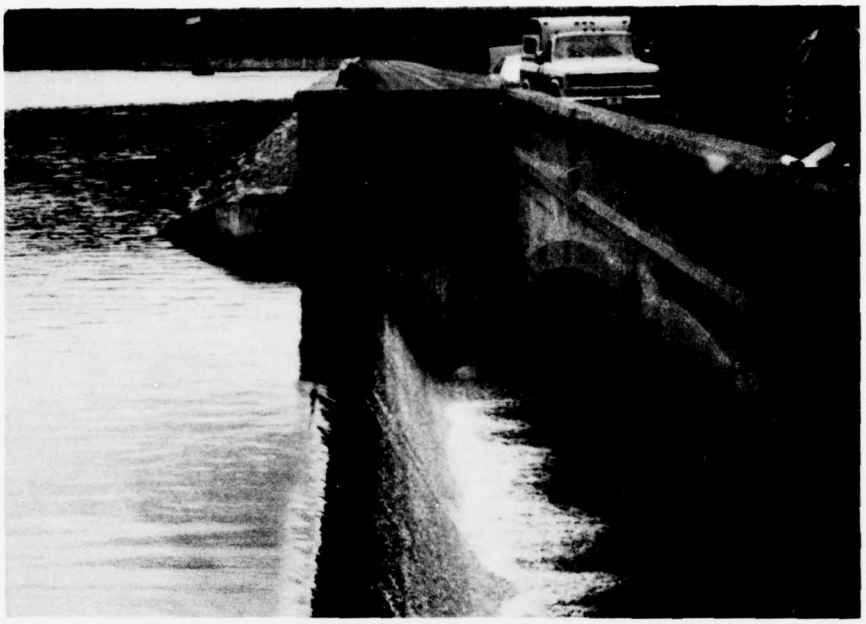
Dam
Looking North

Downstream Slope
and Valve House



Reservoir

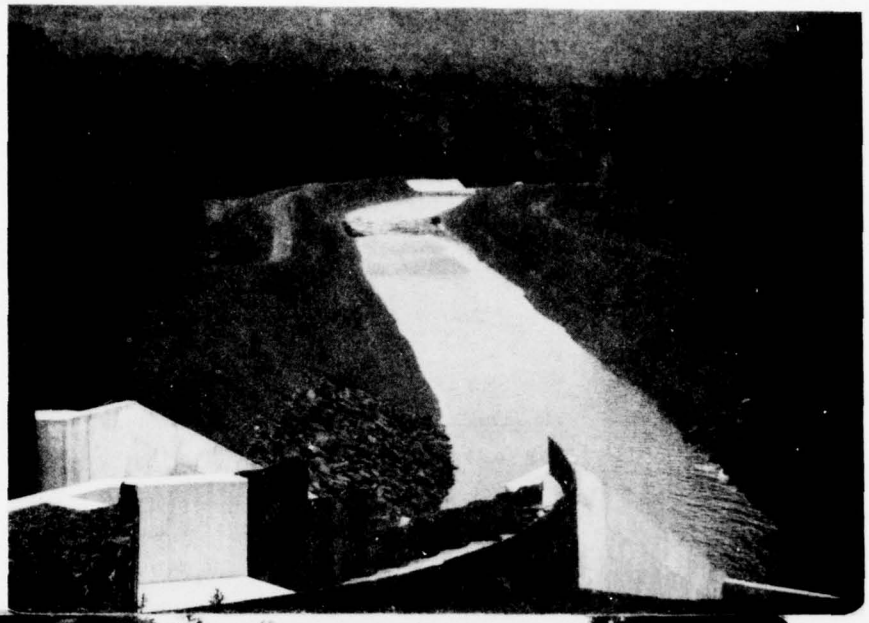
PLATE III



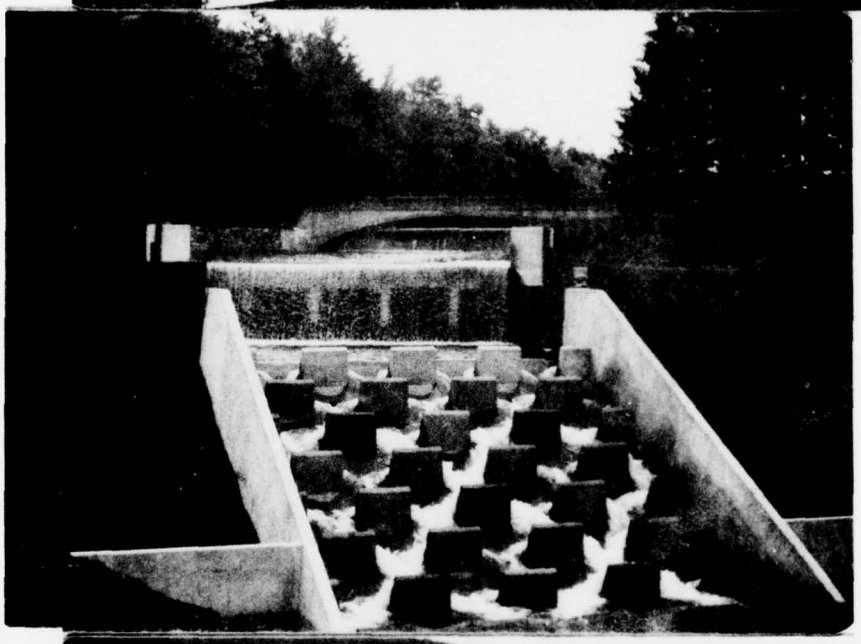
Spillway

Spillway
Below Bridge

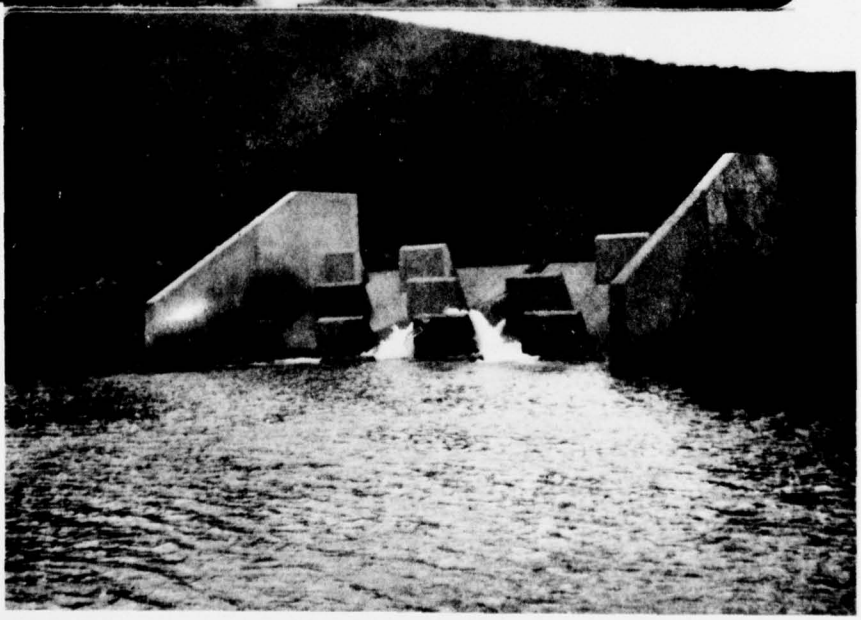
PLATE IV



Spillway
Channel

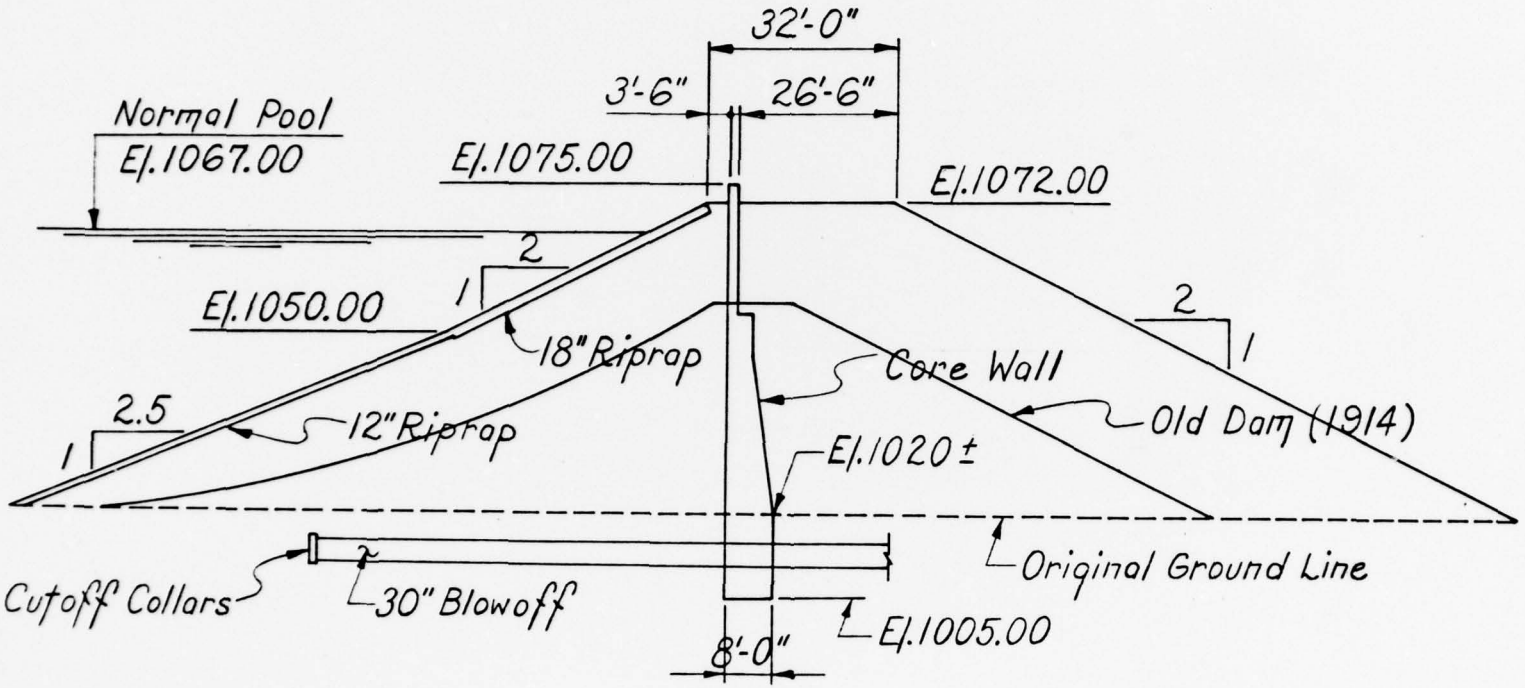


Energy
Dissipators



End of
Spillway

PLATE V

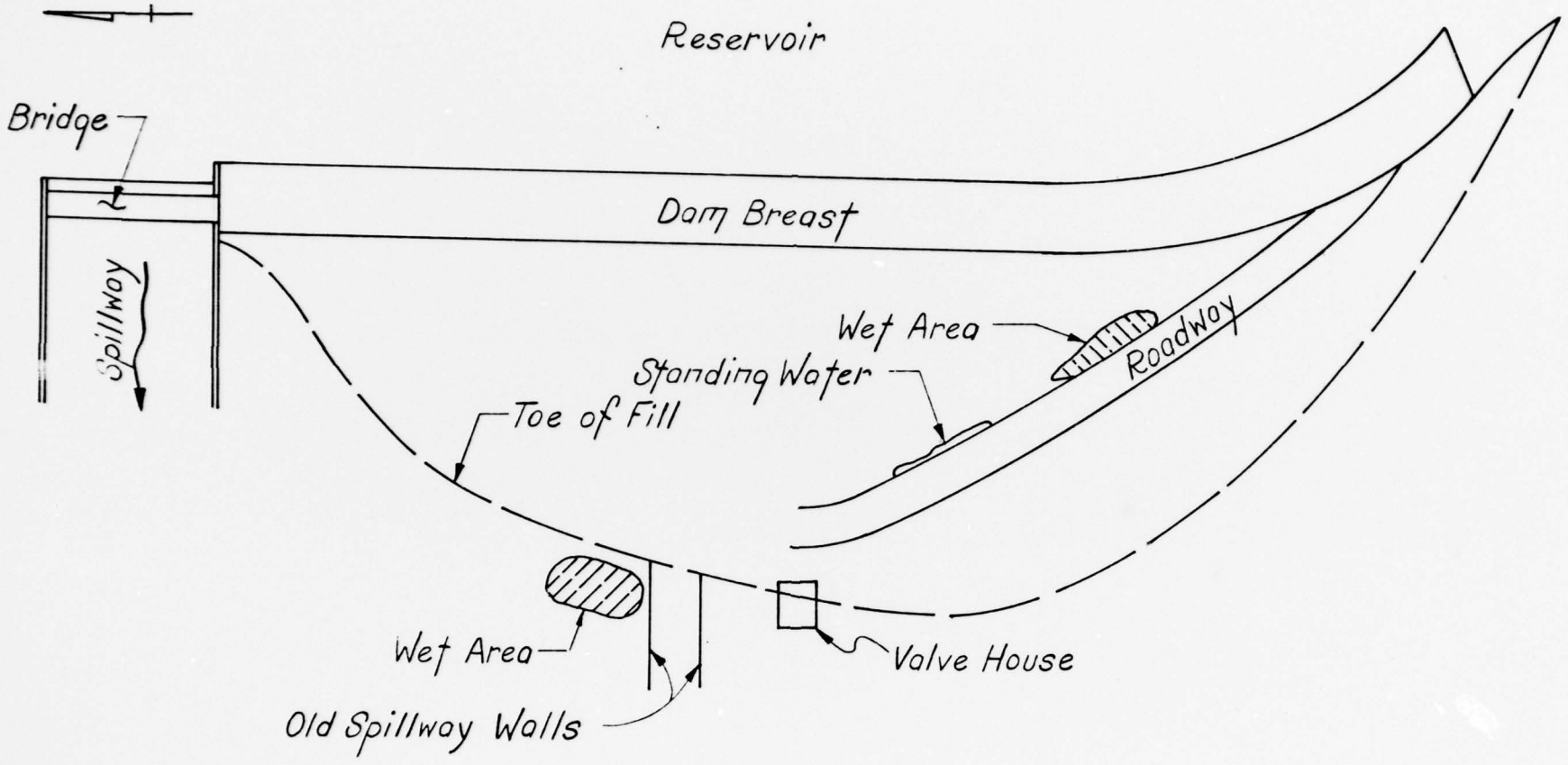


(1924)

TYPICAL DAM SECTION

Scale: 1" = 30'-0"

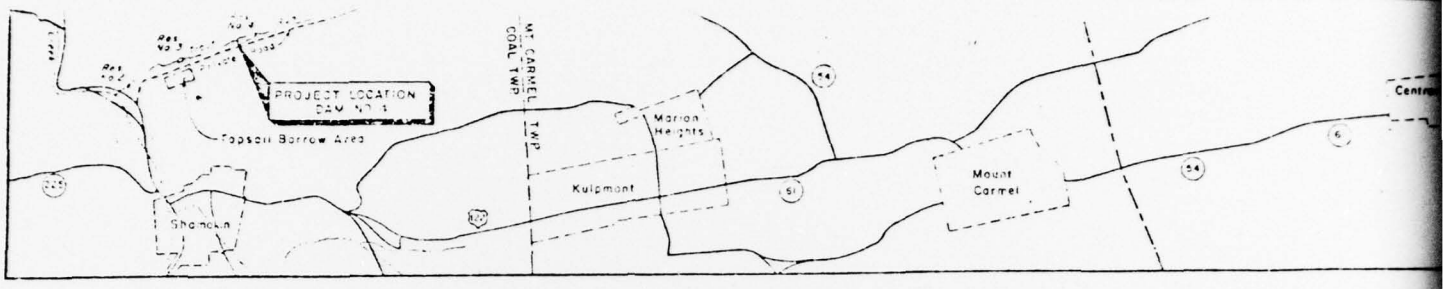
PLATE VI



SCHEMATIC PLAN

No Scale

PLATE VII



LOCATION MAP

SPILLWAY

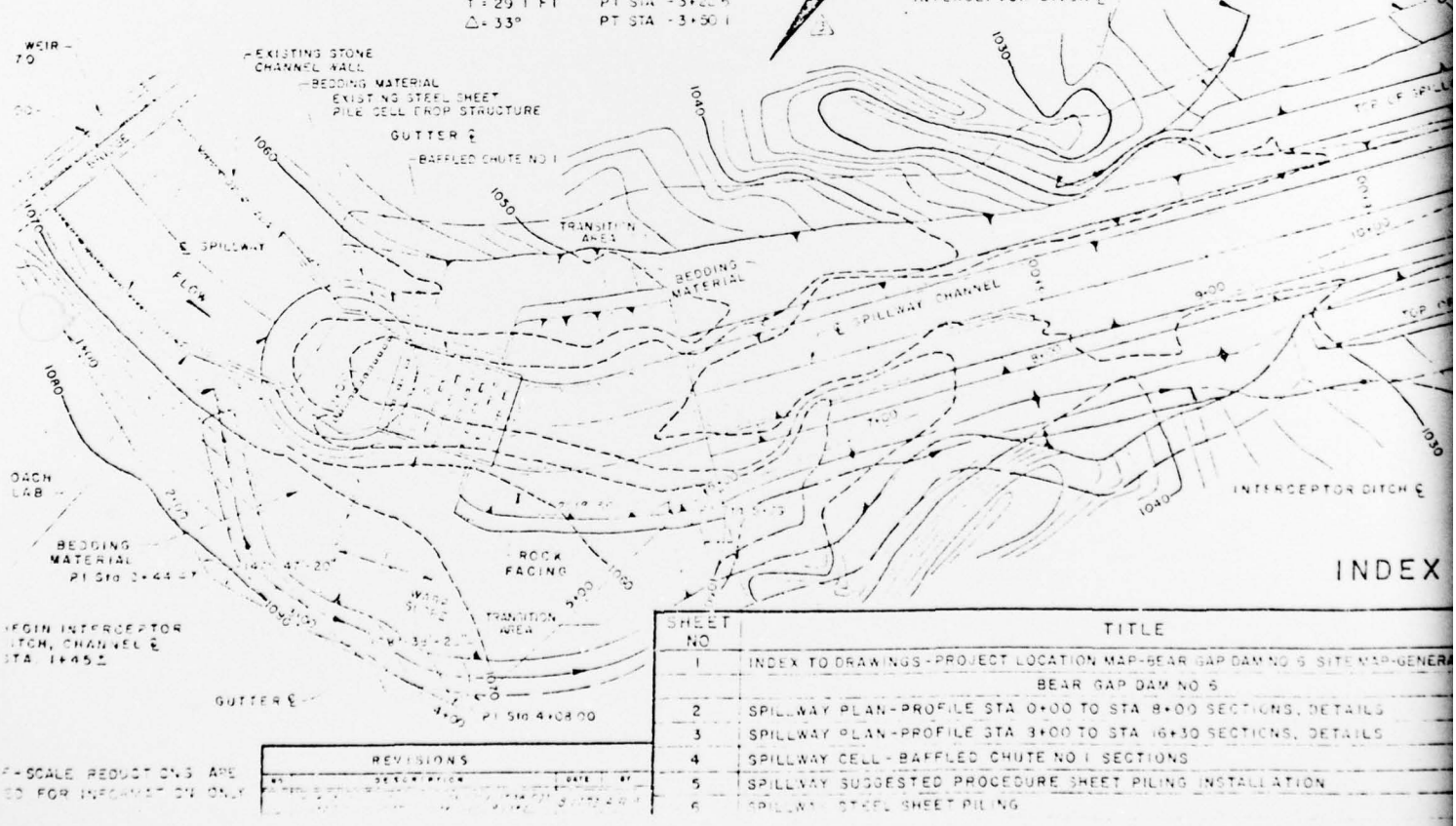
BEAR GAP DAM NO. 6 - T

AN

RELATED RE

CURVE DATA — CURVE NO. 1

R = 98.3 FT	PC STA. -2+93.5
T = 29.1 FT	PI STA. -3+22.6
Δ = 33°	PT STA. -3+50.1

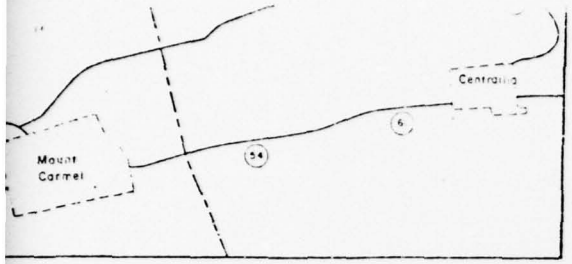


INDEX

SHEET NO.	TITLE
1	INDEX TO DRAWINGS - PROJECT LOCATION MAP - BEAR GAP DAM NO. 6 SITE MAP - GENERA
	BEAR GAP DAM NO. 6
2	SPILLWAY PLAN - PROFILE STA. 0+00 TO STA. 8+00 SECTIONS, DETAILS
3	SPILLWAY PLAN - PROFILE STA. 8+00 TO STA. 16+30 SECTIONS, DETAILS
4	SPILLWAY CELL - BAFFLED CHUTE NO. 1 SECTIONS
5	SPILLWAY SUGGESTED PROCEDURE SHEET PILING INSTALLATION
6	SPILLWAY STEEL SHEET PILING

REVISIONS			
NO.	DESCRIPTION	DATE	BY

F - SCALE REDUCTIONS ARE
ED FOR INFORMATION ONLY



STEEL SHEET PILING DELIVERY POINT

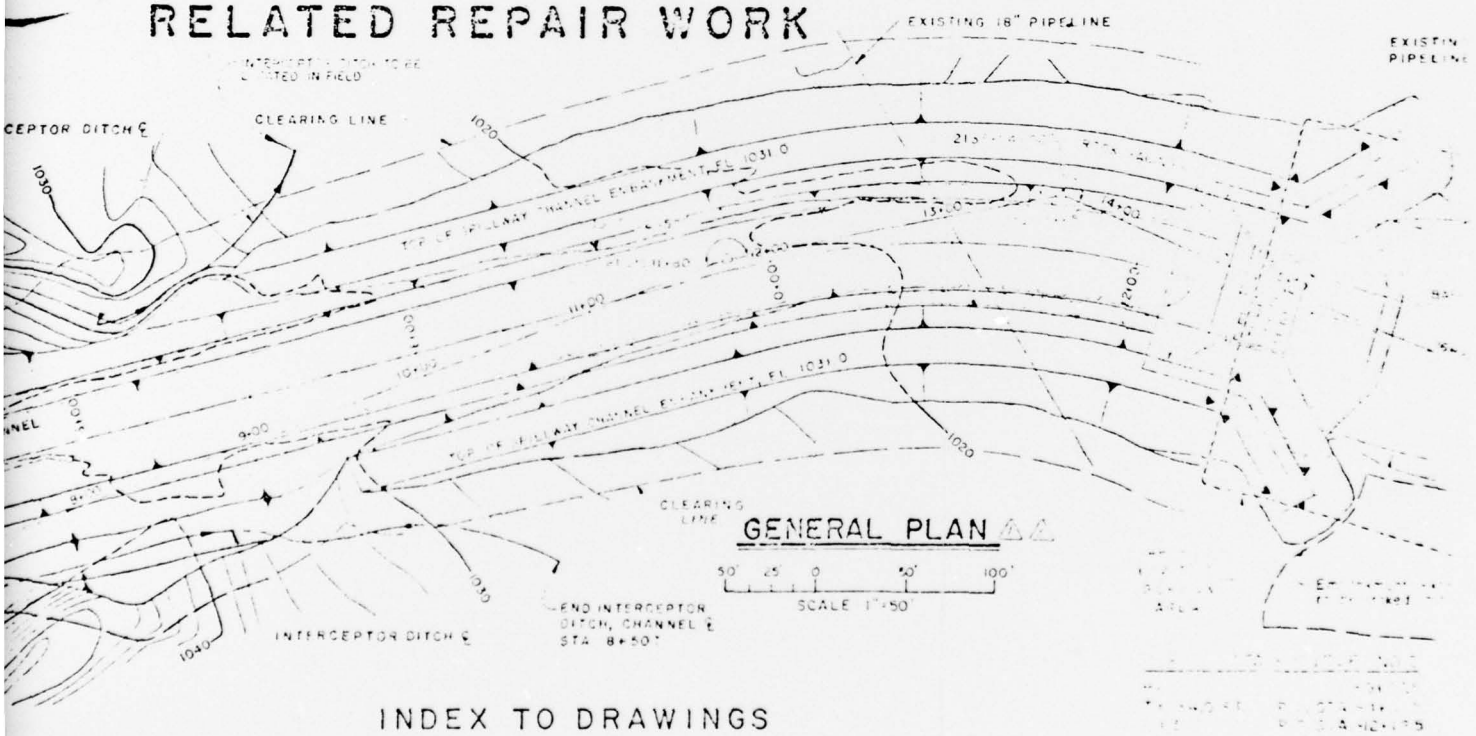
8

SPILLWAY REPAIRS
GAP DAM NO. 6 - TROUT RUN DAM NO. 4
AND
RELATED REPAIR WORK

SITE MAP

400' 0

SCALE



GENERAL PLAN

50' 25 0 50' 100'

SCALE 1"=50'

INDEX TO DRAWINGS

PLATE VII

TITLE	SHEET NO	TITLE
JECT LOCATION MAP-BEAR GAP DAM NO 6 SITE MAP-GENERAL PLAN	10	SPILLWAY BAFFLED CHUTE NO 1 SECTIONS - DETAILS NO 2
BEAR GAP DAM NO 6	11	SPILLWAY BAFFLED CHUTE NO 2 PLAN, SECTIONS, DETAILS
STA 0+00 TO STA 8+00 SECTIONS, DETAILS	12	SPILLWAY BAFFLED CHUTE NO 2 PLAN, PROFILE, SECTIONS, DETAILS
STA 8+00 TO STA 16+30 SECTIONS, DETAILS	13	SPILLWAY SUBSURFACE EXPLORATION LOGS OF CORE BORINGS
D CHUTE NO 1 SECTIONS		TROUT RUN DAM NO 4
ROCEDURE SHEET PILING INSTALLATION	14	SPILLWAY STEEL SHEET PILE WALL PLANS, SECTIONS, DETAILS
ILING	15	SPILLWAY STEEL SHEET PILING

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